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(54) **FAN DEVICE WITH A PREHEAT CIRCULATION CHANNEL**

(57) A fan device includes a base unit (1) having at least one air inlet (11) and an outer tube (13) that defines an accommodation space (131) fluidly communicating with the air inlet (11), and a cover unit (2) having a receiving chamber (21) fluidly communicating with the accommodation space (131), an air outlet (22) fluidly communicating with the receiving chamber (21), and a lower seat (23) including spaced apart inner and outer annular

walls (231, 232), and a connecting wall (233) interconnecting the annular walls (231, 232). A preheat inner tube (3) divides the accommodation space (131) into a heating chamber (134) and a preheat circulation channel (135) that fluidly communicates with each other. A fan unit (4) is disposed in the receiving chamber (21). A heating unit (5) includes a heating component (51) disposed in the heating chamber (134).

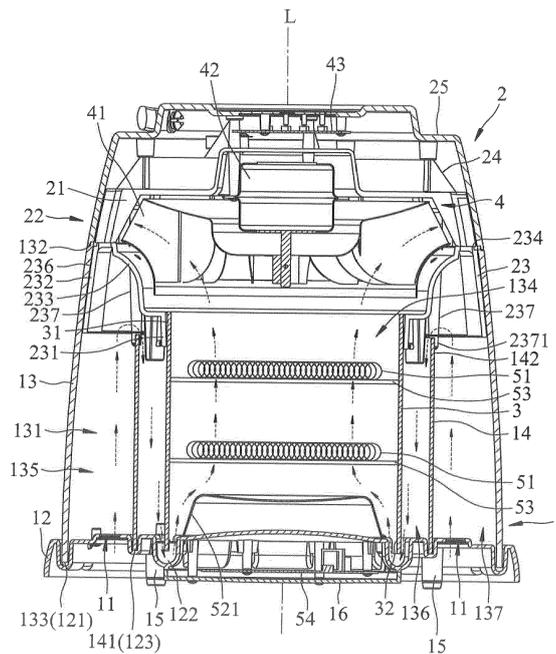


FIG.4

EP 3 112 772 A1

Description

[0001] The disclosure relates to a fan device, more particularly to a fan device with a preheat circulation channel.

[0002] An electrical appliance used for increasing ambient temperature is an electric heater. The most commonly seen electric heaters in the market can be classified according to the different heating principles into halogen types, ceramic types, vane types, etc. The conventional electric heaters mostly have a heating component capable of converting electrical energy into thermal energy. When cold air passes through the heating component and absorbs enough heat, the cold air becomes warm air, and when the warm air is continuously generated, the ambient temperature is increased.

[0003] However, in actual use of the conventional electric heater, because the cold air is in direct contact with the heating component and in large amount, heat generated by the heating component cannot be effectively and rapidly accumulated. It is often required to increase power consumption or time for the heating component to accumulate enough thermal energy and become a stable heat source. Since the heating component of the conventional electric heater directly contacts the cold air, for the heating component to become a stable heat source, a substantial amount of power and time must be consumed. In view of this, the conventional electric heater has a limited effect of warming the air.

[0004] Therefore, an object of this disclosure is to provide a fan device that has a preheat circulation channel and that is capable of enhancing the effect of warming air.

[0005] According to this disclosure, a fan device comprises a base unit, a cover unit, a preheat inner tube, a fan unit and a heating unit. The base unit has at least one air inlet and includes an outer tube defining an accommodation space fluidly communicating with the at least one air inlet. The cover unit is disposed on the base unit and has a receiving chamber fluidly communicating with the accommodation space, and an air outlet fluidly communicating with the receiving chamber. The cover unit includes a lower seat. The lower seat includes an inner annular wall, an outer annular wall spaced apart from the inner annular wall, and a connecting wall interconnecting the inner and outer annular walls.

[0006] The preheat inner tube is disposed in and divides the accommodation space into a heating chamber defined by the preheat inner tube and a preheat circulation channel that is defined cooperatively by the preheat inner tube, the connecting wall and the outer tube and that fluidly communicates with the heating chamber. The preheat inner tube has a top portion disposed in the inner annular wall of the lower seat. The fan unit is disposed in the receiving chamber. The heating unit includes at least one heating component disposed in the heating chamber. When the fan unit is activated, air flows from the air inlet into the preheat circulation channel, and from the preheat circulation channel, the air flows consecutively through the heating chamber and the receiving

chamber and out into an external environment through the air outlet.

[0007] Other features and advantages of the disclosure will become apparent in the following detailed description of the embodiments with reference to the accompanying drawings, of which:

Figure 1 is an exploded perspective view of a fan device according to the first embodiment of the present disclosure;

Figure 2 is a perspective view of one half of the first embodiment in an assembled state, illustrating a preheat inner tube dividing an accommodation space into a heating chamber and a preheat circulation channel;

Figure 3 is a top view of the first embodiment, illustrating the preheat inner tube surrounding a heating component;

Figure 4 is a sectional view of the first embodiment, illustrating how air flows along the paths indicated by dotted-lined arrows when a fan unit is activated;

Figure 5 is a perspective view of one half of a fan device according to the second embodiment of the present disclosure; and

Figure 6 is a sectional view of the second embodiment, illustrating two air inlets being formed in an outer tube and how air flows along the paths indicated by dotted-lined arrows when a fan unit is activated.

[0008] Before the present disclosure is described in greater detail with reference to the accompanying drawings, it should be noted herein that like elements are denoted by the same reference numerals throughout the disclosure.

[0009] Referring to Figures 1 to 4, a fan device according to the first embodiment of the disclosure is shown to include a base unit 1, a cover unit 2, a preheat inner tube 3, a fan unit 4 and a heating unit 5.

[0010] The base unit 1 includes a base plate 12, an outer tube 13, a middle tube 14 and a plurality of leg poles 15. The base plate 12 has a substantially circular cross section, and has a central plate portion 124, an annular inner groove 122 surrounding the central plate portion 124, an annular outer groove 121 spaced apart from the inner groove 122, and an annular middle groove 123 between the inner and outer grooves 122, 121. Two air inlets 11 are respectively formed in two diametrically opposite sides of the base plate 12 between the middle and outer grooves 123, 121

[0011] The outer tube 13 defines an axis (L), and has a top end 132, a bottom end 133 opposite to the top end 132 and engaged with the outer groove 121, and an accommodation space 131 extending from the top end 132 to the bottom end 133. The air inlets 11 fluidly communicate with the accommodation space 131.

[0012] The middle tube 14 has a top portion 142, and a bottom portion 141 engaged with the middle groove

123.

[0013] In this embodiment, four leg poles 15 (only two are shown in Fig. 4) are disposed angularly spaced-apart from each other beneath the base plate 12, and have bottom ends lower than a bottom end of the base plate 12 so as to have a height difference with respect to the bottom end of the base plate 12 (see Fig. 4).

[0014] It is worth to mention that the number of the air inlet 11 may only be one. The purpose of permitting air to flow into the accommodation space 131 via the air inlet 11 may be similarly achieved. Moreover, the number of the leg pole 15 is not limited to four, and may be three. In this case, the three leg poles 15 may be similarly disposed angularly spaced apart from each other beneath the base plate 12, and may similarly have bottom ends lower than the bottom end of the base plate 12 to have a height difference with respect to the same.

[0015] The cover unit 2 is disposed on the base unit 1, and includes a top cover 25 engaged to and covering the top end 132 of the outer tube 13 and defining a receiving chamber 21 that fluidly communicates with the accommodation space 131, a lower seat 23 disposed in the accommodation space 131, an upper seat 24 disposed above the lower seat 23 and located within the receiving chamber 21, an air outlet 22 cooperatively defined by the upper and lower seats 24, 23 and fluidly communicating with the receiving chamber 21, and a handle 26 disposed on the top cover 25 to facilitate handling of the fan device of this disclosure.

[0016] The lower seat 23 includes an outer annular wall 232 having an outer surface 236 abutting against an inner surface of the outer tube 13 in proximity to the top end 132 thereof, an inner annular wall 231 spaced apart from the outer annular wall 232 and proximate to the axis (L), a connecting wall 233 interconnecting the inner and outer annular walls 231, 232, a plurality of angularly spaced-apart studs 235 that protrude from a top end 234 of the outer annular wall 232 toward the upper seat 24 and that divide the air outlet 22 into a plurality of air outlet openings 221, and a plurality of angularly spaced-apart rib plates 237 projecting downward from the connecting wall 233 and having bottom portions 2371 abutting against and surrounding the top portion 142 of the middle tube 14. The inner annular wall 231 tapers from a top end to a bottom end thereof.

[0017] In this embodiment, the top cover 25 is formed with a plurality of ventilation windows 251 fluidly communicating with the air outlet openings 221, respectively. Each ventilation window 251 is in the form of a palisade. When air flowing out of the air outlet openings 221 encounters the palisade-shaped ventilation windows 251, part of the air cannot flow through in certain areas but form a partial cyclone. Not only the mixing of the air can be assisted, but also the flow of the air cannot be limited to only a single horizontal direction.

[0018] The preheat inner tube 3 surrounds the axis (L), and has a top portion 31 disposed in the inner annular wall 231, and a bottom portion 32 extending into the inner

groove 122. It is worth mentioning that the top portion 31 abuts tightly against the inner annular wall 231 to prevent leakage of air therebetween. The preheat inner tube 3 is disposed in and divides the accommodation space 131 into a heating chamber 134 defined by the preheat inner tube 3 and a preheat circulation channel 135 defined cooperatively by the preheat inner tube 3, the connecting wall 233 and the outer tube 13. The preheat circulation channel 135 fluidly communicates with the heating chamber 134 through a gap that is formed between the bottom portion 32 of the preheat inner tube 3 and a wall defining the annular inner groove 122.

[0019] The middle tube 14 is disposed between the preheat inner tube 3 and the outer tube 13, and divides the preheat circulation channel 135 into an inner channel section 136 between the middle tube 14 and the preheat inner tube 3 and an outer channel section 137 between the middle and outer tubes 14, 13. The outer channel section 137 fluidly communicates with the inner channel section 136 through spaces formed between the rib plates 237. The inner and outer channel sections 136, 137, the heating chamber 134 and the receiving chamber 21 all fluidly communicate with one another. The air inlets 11 are located between the middle and outer tubes 14, 13 and fluidly communicate with the outer channel section 137.

[0020] The fan unit 4 is disposed in the receiving chamber 21, and is located above the lower seat 23. The fan unit 4 includes a fan 41 disposed between the upper and lower seats 24, 23, a motor 42 that drives the fan 41, and a fan control circuit board 43 disposed above the upper seat 24 and connected to the top cover 25. The fan control circuit board 43 regulates the speed of the motor 42 to change the force of the wind generated by the fan 41.

[0021] The heating unit 5 includes two heating components 51 disposed in the heating chamber 134, a reflective plate 52 disposed on the base plate 12 corresponding in position to the central plate portion 124 and located within the heating chamber 134, six cross bars 53 (only three are visible in Fig. 3), and a heating control circuit board 54. In this embodiment, each heating component 51 is a U-shaped metal coil spring (see Fig. 3) for passing of an electric current therethrough. The heating principle is based on Joule's law which converts electrical energy into thermal energy.

[0022] The reflective plate 52 may be made of a metal material with high heat reflectivity, or the surface of the reflective plate 52 may be coated with a layer of composite material with high heat reflectivity, so that the thermal energy generated by the heating components 51 can be concentrated and rapidly accumulated inside the heating chamber 134. In this embodiment, the reflective plate 52 is made of a metal material with high heat reflectivity, and has an inverted bowl shape with a peripheral wall 521 that tapers from a bottom end to a top end thereof away from the central plate portion 124. Such a design can guide air to flow upward and to prevent air, which has not absorbed sufficient heat and which has a large den-

sity, from being retained in the heating chamber 34, especially in the area proximate to the base plate 12. It should be noted that, in an alternative embodiment, the reflective plate 52 may be omitted, and the surface of the central plate portion 124 may be coated with a layer of composite material with high heat reflectivity. Similarly, the thermal energy generated by the heating components 51 can be rapidly accumulated inside the heating chamber 134.

[0023] The cross bars 53 are connected to two opposite sides of the preheat inner tube 3, and extend across the heating chamber 134 above the reflective plate 52. In this embodiment, the cross bars 53 are arranged in two rows, one above the other. Each row includes three spaced-apart cross bars 53 that contact and support a corresponding one of the heating components 51. The cross bars 53 can help conduct thermal energy to the preheat inner tube 3. Further, the heating components 51 can also transfer thermal energy to the preheat inner tube 3 by radiation. The preheat inner tube 3 that acquires the thermal energy will, in turn, transmit the thermal energy to the air in the preheat circulation channel 135, so that the air in the preheat circulation channel 135 can be initially preheated. As such, cold air can be completely prevented from directly contacting the heating components 51 so that the heat generated by the heating components 51 can be effectively accumulated in the heating chamber 134, and the heating components 51 can rapidly become a stable high temperature heat source. That is, in the present disclosure, the time and the power consumption required for heating the heating components 51 can be significantly reduced. In comparison with the conventional electric heater, the present disclosure is more capable of enhancing the effect of warming air.

[0024] It is worth mentioning that the number of each of the heating component 51 and the cross bar 53 may be one. The effect of initially preheating the air disposed in the preheat circulation channel 135 may similarly be achieved.

[0025] In this embodiment, the base unit 1 further includes an insulating shell 16 connected to the base plate 12 opposite to the reflective plate 52 and accommodating the heating control circuit board 54. The heating control circuit board 54 is used to regulate the temperature of the heating components 51.

[0026] Referring to Figure 4, in operation, the heating components 51 follow the Joule's Law and convert electrical energy into thermal energy, and the heating chamber 134 becomes a high temperature region and sequentially transmits the thermal energy to the preheat inner tube 3 and the preheat circulation channel 135. Further, when the fan unit 4 is activated, air flows rapidly from the air inlets 11 into the outer and inner channel sections 137, 136 of the preheat circulation channel 135. At this moment, the air in the preheat circulation channel 135 is initially preheated, after which it flows consecutively through the heating chamber 134 and the receiving chamber 21, and out into the external environment via

the air outlet openings 221 and the ventilation windows 251. The flow paths of the air are indicated by dotted-lined arrows, as shown in Fig. 4.

[0027] Because the fan device of the present disclosure is designed with the preheat circulation channel 135, it can prevent cold air from directly entering the heating chamber 134, so that the air discharged from the heating chamber 134 is ensured to be warm air, but not cold air.

[0028] Referring to Figures 5 to 6, the second embodiment of a fan device according to the present disclosure is shown to be generally identical to the first embodiment. However, in this embodiment, the two air inlets 11 are respectively formed in two diametrically opposite sides of the outer tube 13 between the top and bottom ends 132, 133 thereof or between the lower seat 23 and the base plate 12. Furthermore, the middle tube 14 is omitted herein.

[0029] When the heating unit 5 and the fan unit 4 are activated together, air can rapidly flow from the air inlets 11 of the outer tube 13 into the preheat circulation channel 135. At this moment, the air in the preheat circulation channel 135 is initially preheated, after which it flows consecutively through the heating chamber 134 and the receiving chamber 21, and out into the external environment via the air outlet openings 221 and the ventilation windows 251. The flow paths of the air are indicated by dotted-lined arrows, as shown in Fig. 6. The purpose and efficiency of the first embodiment can be similarly achieved using the second embodiment.

[0030] In sum, in the fan device of the present disclosure, cold air is flowed into the preheat circulation channel 135 and is not in direct contact with the heating components 51, so that the heating components 51 can effectively accumulate thermal energy. Furthermore, the thermal energy can be transmitted to the preheat inner tube 3 by radiation or through the cross bars 53, and the preheat inner tube 3, in turn, heats the air in the preheat circulation channel 135. In comparison with the conventional electric heater, the present disclosure, not only can enhance the effect of warming air, but also can ensure the air flowing out into the external environment is warm air having a constant temperature, but not cold air. Therefore, the object of the present disclosure can be achieved.

Claims

1. A fan device comprising:

- a base unit (1) having at least one air inlet (11) and including an outer tube (13) that defines an accommodation space (131) fluidly communicating with said at least one air inlet (11);
- a cover unit (2) disposed on said base unit (1) and having a receiving chamber (21) fluidly communicating with said accommodation space (131), and an air outlet (22) fluidly communicating with said receiving chamber (21), said cover

- unit (2) including a lower seat (23), said lower seat (23) including an inner annular wall (231), an outer annular wall (232) spaced apart from said inner annular wall (231), and a connecting wall (233) interconnecting said inner and outer annular walls (231, 232);
 a preheat inner tube (3) disposed in and dividing said accommodation space (131) into a heating chamber (134) defined by said preheat inner tube (3) and a preheat circulation channel (135) that is defined cooperatively by said preheat inner tube (3), said connecting wall (233) and said outer tube (13) and that fluidly communicates with said heating chamber (134), said preheat inner tube (3) having a top portion (31) disposed in said inner annular wall (231) of said lower seat (23);
 a fan unit (4) disposed in said receiving chamber (21); and
 a heating unit (5) including at least one heating component (51) disposed in said heating chamber (134);
 wherein, when said fan unit (4) is activated, air flows from said air inlet (11) into said preheat circulation channel (135), and from said preheat circulation channel (135), the air flows consecutively through said heating chamber (134) and said receiving chamber (21) and out into an external environment through said air outlet (22).
2. The fan device as claimed in Claim 1, wherein said base unit (1) further includes a base plate (12) having an annular outer groove (121), and said outer tube (13) has a bottom end (133) engaged with said annular outer groove (121).
 3. The fan device as claimed in Claim 2, wherein said air inlet (11) is formed in said outer tube (13) and is located between said lower seat (23) and said base plate (12).
 4. The fan device as claimed in Claim 1, wherein said air inlet (11) is formed in said base plate (12) between said preheat inner tube (3) and said outer tube (13).
 5. The fan device as claimed in Claim 4, wherein said base plate (12) further has an annular inner groove (122) spaced apart from said annular outer groove (121), and an annular middle groove (123) between said annular inner and outer grooves (122, 121), said base unit (1) further including a middle tube (14) that is disposed between said preheat inner tube (3) and said outer tube (13) and that divides said preheat circulation channel (135) into an inner channel section (136) between said middle tube (14) and said preheat inner tube (3) and an outer channel section (137) between said middle and outer tubes (14, 13), said middle tube (14) having a bottom portion (141) engaged with said middle groove (123), and wherein, said inner and outer channel sections (136, 137), said heating chamber (134) and said receiving chamber (21) all fluidly communicate with one another, and said air inlet (11) is located between said middle and outer tubes (14, 13).
 6. The fan device as claimed in Claim 1, wherein said base plate (12) further has a central plate portion (124) surrounded by said annular inner groove (122), said heating unit (5) further including a reflective plate (52) disposed on said base plate (12) corresponding in position to said central plate portion (124) and located within said heating chamber (134), and at least one cross bar (53) disposed in said heating chamber (134) and contacting said at least one heating component (51).
 7. The fan device as claimed in Claim 6, wherein said reflective plate (52) has an inverted bowl shape with a peripheral wall (521) that tapers from a bottom end to a top end thereof.
 8. The fan device as claimed in Claim 1, wherein said cover unit (2) further includes an upper seat (24) disposed above and cooperating with said lower seat (23) to define said air outlet (22), said lower seat (23) further including a plurality of angularly spaced-apart studs (235) that protrude from a top end of said outer annular wall (232) toward said upper seat (24) and that divide said air outlet (22) into a plurality of air outlet openings (221), said fan unit (4) including a fan (41) disposed between said upper and lower seats (24, 23), and a motor (42) that drives said fan (41).
 9. The fan device as claimed in Claim 8, wherein said cover unit (2) further includes a top cover (25) disposed on and covering a top end (132) of said outer tube (13), and a handle (26) disposed on said top cover (25), said top cover (25) being formed with a plurality of ventilation windows (251) fluidly communicating with said air outlet openings (221), respectively.
 10. The fan device as claimed in Claim 9, wherein said fan unit (4) further includes a fan control circuit board (43) disposed above said upper seat (24) and connected to said top cover (25), said heating unit (5) further including a heating control circuit board (54), said base unit (1) further including an insulating shell (16) connected to said base plate (12) opposite to said reflective plate (52) and accommodating said heating control circuit board (54).
 11. The fan device as claimed in Claim 10, wherein said base unit (1) further includes at least three leg poles (15) disposed angularly spaced apart from each other.

er beneath said base plate (12) and having bottom ends lower than a bottom end of said base plate (12) .

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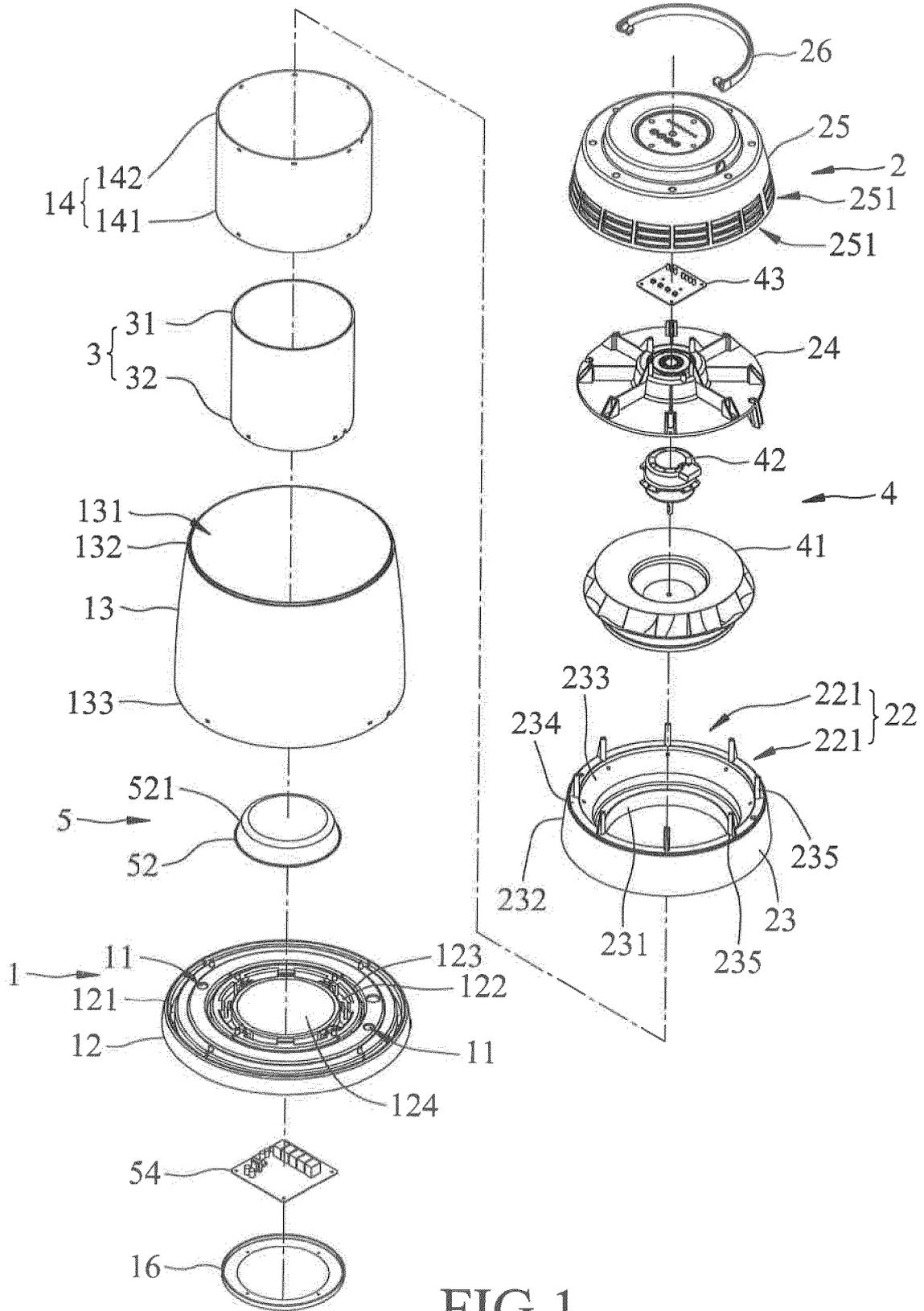


FIG.1

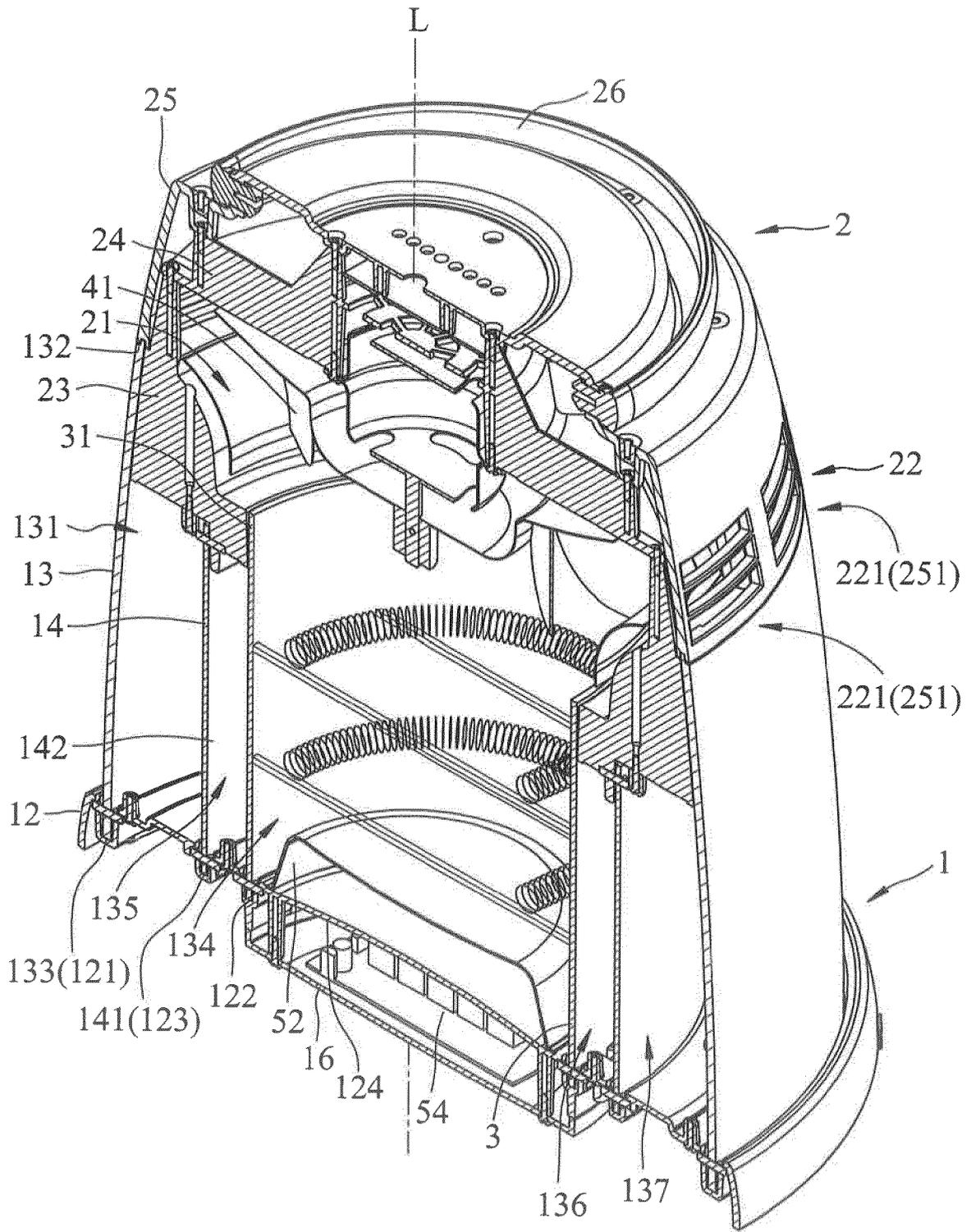


FIG. 2

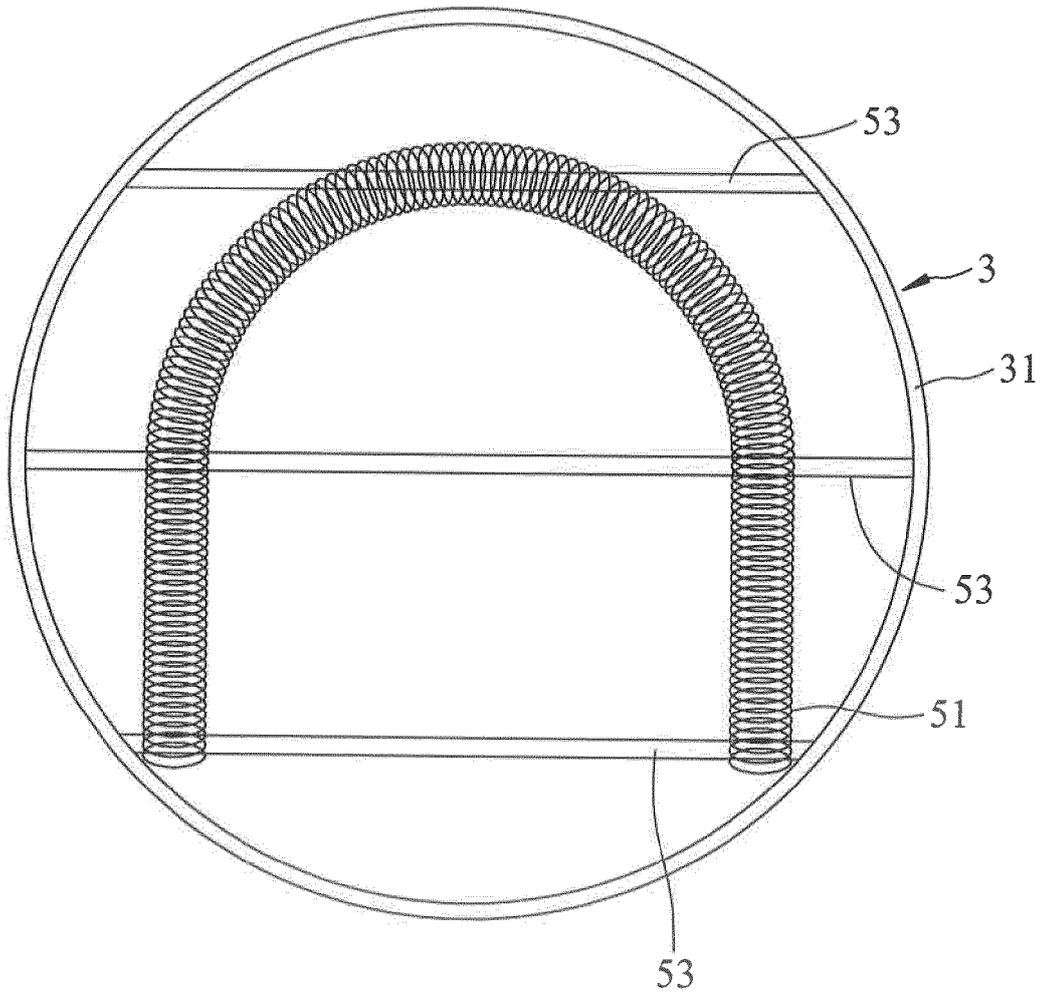


FIG.3

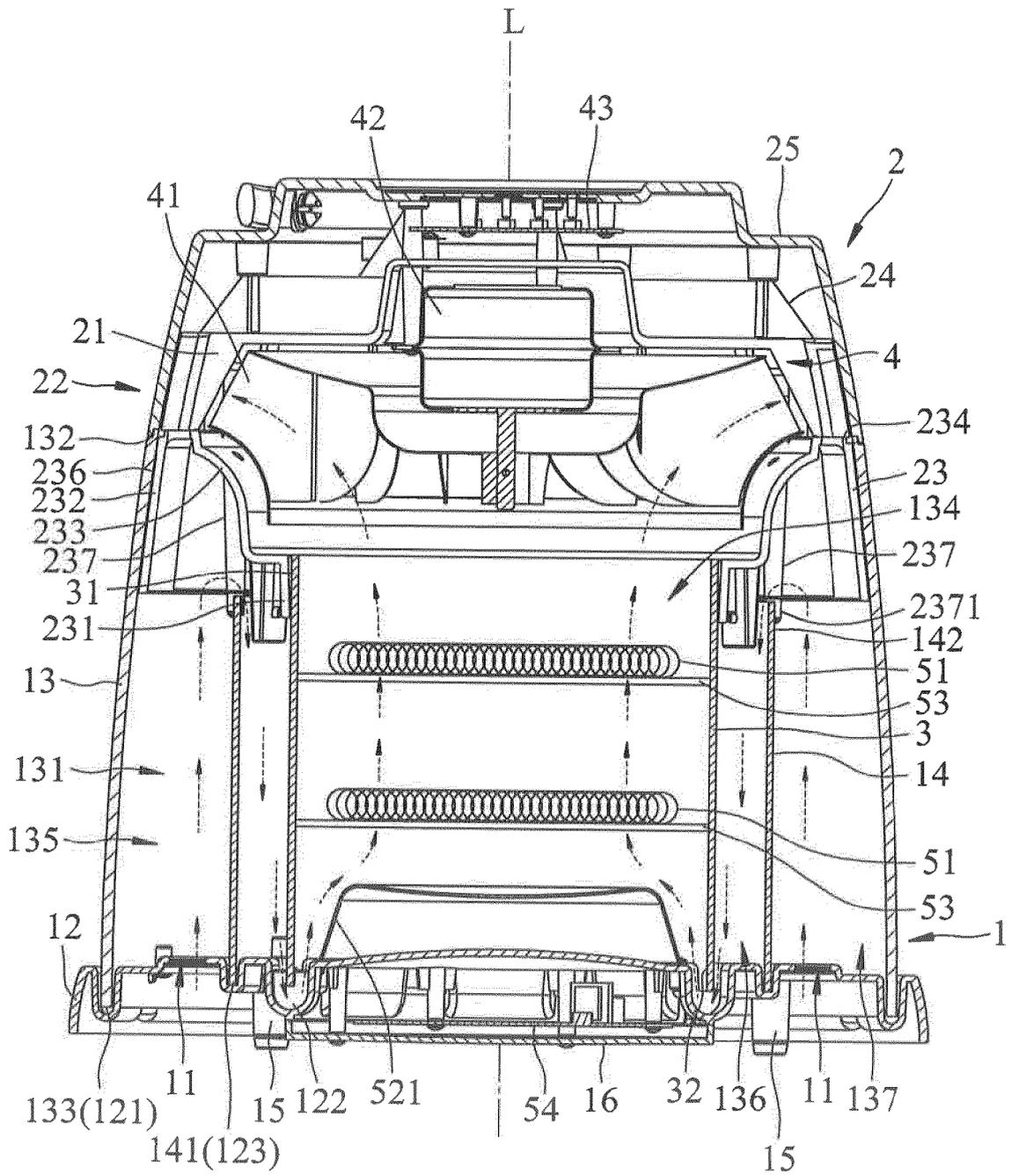


FIG.4

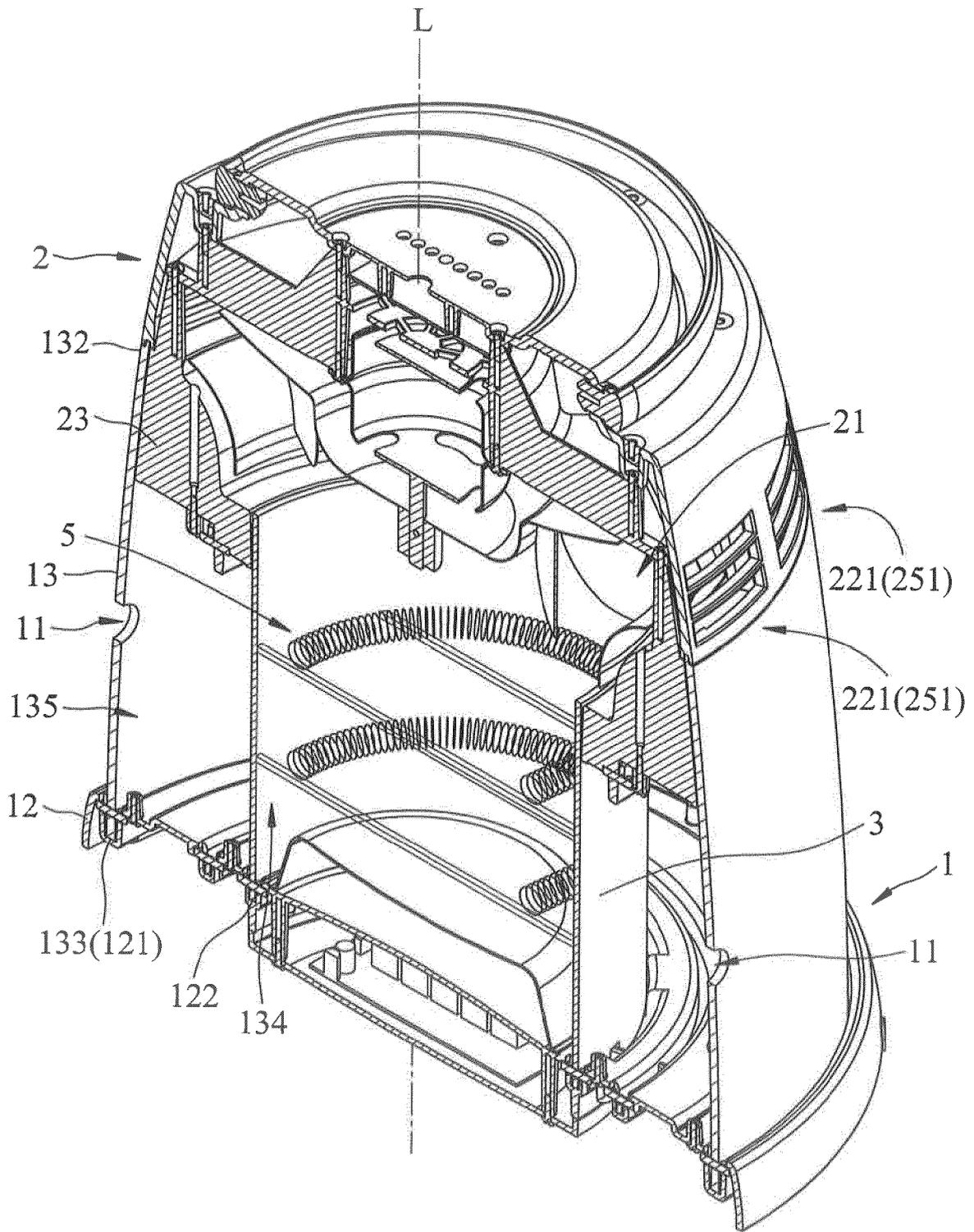


FIG. 5

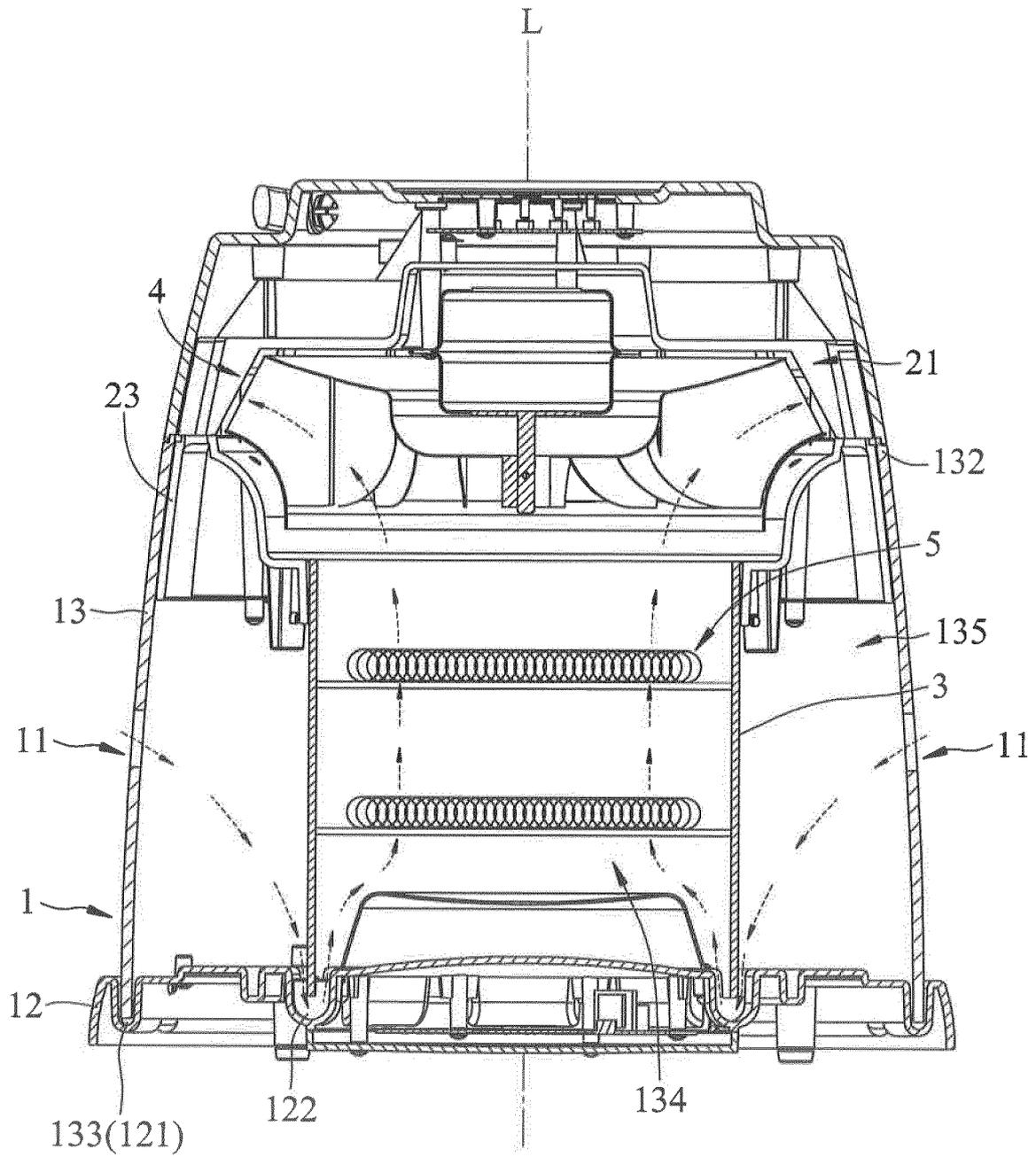


FIG. 6



EUROPEAN SEARCH REPORT

Application Number
EP 15 17 4491

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 2011/002672 A1 (KRAPP THOMAS E [US] ET AL) 6 January 2011 (2011-01-06) * paragraph [0031]; figures 9,10 * -----	2-11	INV. F24H3/04 F24H9/00 F24H9/02 F24H9/18 F24H9/20 H05B3/00
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A	GB 1 321 232 A (BELLING & CO LTD) 27 June 1973 (1973-06-27) * claim 1; figures 1-3 * -----	1-11	
The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (IPC)
			F24H H05B
Place of search		Date of completion of the search	Examiner
Munich		3 December 2015	Degen, Marcello
CATEGORY OF CITED DOCUMENTS			
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

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**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 15 17 4491

5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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03-12-2015

10	Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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